

# Jeffrey M. Pietryga

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## EDUCATION

**Ph.D., Chemistry**, with a concentration in Inorganic Chemistry, University of Texas at Austin, Austin, TX, 2002

Thesis title: "Synthetic Approaches to Problems in Materials Science: Development of Novel Organometallic Compounds for Specific Applications"

Advisor: Professor Alan H. Cowley

**BS in Chemistry**, Honors Concentration, with High Honors, minor in Computer Science, University of Michigan-Flint, Flint, MI, 1997

## EXPERIENCE

2012- **Affiliated Faculty**, Department of Chemical Engineering, New Mexico State University Las Cruces, NM

2007- **Technical Staff Member/R&D Scientist**, Chemistry Division, Los Alamos National Laboratory, Los Alamos, NM

2005-2007 **Intelligence Community Postdoctoral Research Fellow**, Los Alamos National Laboratory Los Alamos, NM

2003-2005 **Postdoctoral Research Associate**, Chemistry Division, Los Alamos National Laboratory Los Alamos, NM

1997-2002 **Graduate Research Assistant/Teaching Assistant**, University of Texas at Austin, Austin, TX

1994-1997 **Assistant Materials Analyst (Co-op)**, Delphi Automotive Systems, Flint, MI

## PUBLICATIONS

>1500 citations, h-index 17 (*Google Scholar*)

32. Bae, W.K.; Joo, J.; Padilha, L.A.; Won, J.; Lee, D.C.; Lin, Q.; Koh, W.-k.; Luo, H.; Klimov, V.I. and **J.M. Pietryga**, Highly Effective Surface Passivation of PbSe Quantum Dots through Reaction with Molecular Chlorine, *J. Am. Chem. Soc.*, **2012**, 134, ASAP.
31. Pandey, A.; Brovelli, S.; Viswanatha, R.; Li, L.; **Pietryga, J.M.**; Klimov, V.I. and S.A. Crooker, Long-lived photoinduced magnetization in copper-doped ZnSe-CdSe core-shell nanocrystals, *Nature Nanotech.*, **2012**, 7, 792-797.
30. Sandberg, R.L.; Padilha, L.A.; Qazilbash, M.M.; Bae, W.K.; Schaller, R.D.; **Pietryga, J.M.**; Stevens, M.J.; Baek, B.; Nam, S.W. and V.I. Klimov, Multiexciton Dynamics in Infrared-Emitting Colloidal Nanostructures Probed by a Superconducting Nanowire Single-Photon Detector, *ACS Nano*, **2012**, 6, 9532-9540.
29. Khanal, B.P.; Pandey, A.; Li, L.; Lin, Q.; Bae, W.K.; Luo, H.; Klimov, V.I. and **J. M. Pietryga**, Generalized Synthesis of Hybrid Metal-Semiconductor Nanostructures Tunable from the Visible to the Infrared, *ACS Nano*, **2012**, 6, 3832-3840.
28. Stewart, J. T.; Padilha, L.A.; Qazilbash, M.M.; **Pietryga, J.M.**; Midgett, A.G.; Luther, J.M.; Beard, M.C.; Nozik, A.J. and V.I. Klimov, Comparison of carrier multiplication yields in PbS and PbSe nanocrystals: The role of competing energy-loss processes, *Nano Lett.*, **2012**, 12, 622-628.

27. Viswanatha, R.; **Pietryga, J.M.**, Klimov, V.I. and S.A. Crooker, Spin-polarized Mn<sup>2+</sup> emission from Mn-doped colloidal nanocrystals, *Phys. Rev. Lett.*, **2011**, 107, 067402.
26. Padilha, L.A.; Robel, I.; Lee, D.C.; Nagpal, P.; **Pietryga, J.M.** and V.I. Klimov, Spectral Dependence of Nanocrystal Photoionization Probability: The Role of Hot-Carrier Transfer, *ACS Nano*, **2011**, 5, 5045-55.
25. Li, L.; Pandey, A.; Werder, D.J.; Khanal, B.K.; **Pietryga, J.M.** and V.I. Klimov, Efficient synthesis of highly luminescent copper indium sulfide based core/shell nanocrystals with surprisingly long-lived emission, *J. Am. Chem. Soc.*, **2011**, 133, 1176-9.
24. McGuire, J.A.; Sykora, M.; Robel, I.; Padilha, L.A.; Joo, J.; **Pietryga, J.M.** and V.I. Klimov, Spectroscopic Signatures of Photocharging due to "Hot" Carrier Transfer in Solutions of Semiconductor Nanocrystals under Low-Intensity Ultraviolet Excitation, *ACS Nano*, **2010**, 4, 6087-6097.
23. Schaller, R.D.; Crooker, S.A.; Bussian, D.A.; Pietryga, J.M.; Joo, J. and V.I. Klimov, Revealing the Exciton Fine Structure of PbSe Nanocrystal Quantum Dots Using Optical Spectroscopy in High Magnetic Fields. *Phys. Rev. Lett.* **2010**, 105, 067403.
22. Lee, D.C.; Robel, I.; **Pietryga, J.M.** and V.I. Klimov, Infrared-Active Heterostructured Nanocrystals with Ultralong Carrier Lifetimes. *J. Am. Chem. Soc.* **2010**, 132, 9960-2.
21. McGuire, J.A.; Sykora, M.; Joo, J.; **Pietryga, J.M.** and V.I. Klimov, Apparent Versus True Carrier Multiplication Yields in Semiconductor Nanocrystals. *Nano Lett.* **2010**, 10, 2049-57.
20. Sykora, M.; Koposov, A.Y.; McGuire, J.A.; Schulze, R.K.; Tretiak, O.; **Pietryga, J.M.** and V.I. Klimov, Effect of Air Exposure on Surface Properties, Electronic Structure and Carrier Relaxation in PbSe Nanocrystals. *ACS Nano* **2010**, 4, 2021-34.
19. Joo, J.; **Pietryga, J.M.**; McGuire, J.A.; Jeon, S.; Williams, D.J.; Wang, H.-L. and V.I. Klimov, A Reduction Pathway in the Synthesis of PbSe Nanocrystal Quantum Dots. *J. Am. Chem. Soc.*, **2009**, 131, 10620-8.
18. Lee, D.C.; **Pietryga, J.M.**; Robel, I.; Werder, D.J.; Schaller, R.D. and V.I. Klimov. Colloidal synthesis of infrared-emitting germanium nanocrystals. *J. Am. Chem. Soc.*, **2009**, 131, 3436-7.
17. McGuire, J.A.; Joo, J.; **Pietryga, J.M.**; Schaller, R.D. and V.I. Klimov, New aspects of carrier multiplication in semiconductor nanocrystals. *Acc. Chem. Res.* **2008**, 41, 1810-9.
16. **Pietryga, J.M.**; Zhuravlev, K.K.; Whitehead, M.; Klimov, V.I. and R.D. Schaller, Evidence for Barrierless Auger Recombination in PbSe Nanocrystals: A Pressure-Dependent Transient Absorption Study. *Phys. Rev. Lett.* **2008**, 101, 217401.
15. Wang, F.; Yu, H.; Jeong, S.; **Pietryga, J.M.**; Hollingsworth, J.A.; Gibbons, P.C. and W.E. Buhro, The Scaling of the Effective Band Gaps in Indium-Arsenide Quantum Dots and Wires. *ACS Nano* **2008**, 2, 1903-13.
14. **Pietryga, J.M.**; Werder, D.J. ; Williams, D.J.; Casson, J.L.; Schaller, R.D.; Klimov, V.I. and J.A. Hollingsworth, Utilizing the lability of lead selenide to produce heterostructured nanocrystals with bright, stable infrared emission. *J. Am. Chem. Soc.*, **2008**, 130, 4879-85.
13. Schaller, R.D.; **Pietryga, J.M.** and V.I. Klimov, Carrier Multiplication in InAs Nanocrystal Quantum Dots with an Onset Defined by the Energy Conservation Limit. *Nano Lett.* **2007**, 7, 3469-76.

12. Jiang, X.; Schaller, R.D.; Lee, S.B.; **Pietryga, J.M.**; Klimov, V.I. and A.A. Zakhidov, PbSe Nanocrystal/Conducting Polymer Solar Cells with 2 Microns Infrared Response. *J. Mater. Res.*, **2007**, 22, 2204-10.
11. Zhuravlev, K.K.; **Pietryga, J.M.**; Sander, R.K. and R.D. Schaller, Optical Properties of PbSe Nanocrystal Quantum Dots Under Pressure. *Appl. Phys. Lett.*, **2007**, 90, 043110.
10. Sapra, S.; Nanda, J.; **Pietryga, J.M.**; Hollingsworth, J.A. and D.D. Sarma, Unraveling internal structures of highly luminescent PbSe Nanocrystallites using variable-energy synchrotron radiation photoelectron spectroscopy. *J. Phys. Chem. B.*, **2006**, 110(31), 15244-15250.
9. Schaller, R.D.; Sykora, M.; **Pietryga, J.M.** and V.I. Klimov, Seven excitons at a cost of one: Redefining the limits for conversion efficiency of photons into charge carriers. *Nano Lett.*, **2006**, 6, 424-429.
8. Maskaly, G.R.; Petruska, M.A.; Nanda, J.; Bezel, I.V.; Schaller, R.D.; Htoon, H.; **Pietryga, J.M.** and V.I. Klimov, Amplified spontaneous emission in semiconductor-nanocrystal/synthetic-opal composites: optical-gain enhancement via a photonic crystal pseudogap. *Adv. Mater.*, **2006**, 18, 343-7.
7. **Pietryga, J.M.**; Jones, J.N.; Macdonald, C.L.B.; Moore, J.A. and A.H. Cowley, Titanium(IV) complexes with amidinate and/or hydrazido ligands. *Polyhedron*, **2006**, 25, 259-265.
6. Jiang, X.; Lee, S.B.; Altfeder, I.B.; Zakhidov, A.A.; Schaller, R.D.; **Pietryga, J.M.** and V.I. Klimov, Nanocomposite solar cells based on conjugated polymer/PbSe quantum dot. *Proc. SPIE Int. Soc. Opt. Eng.*, **2005**, 5938, 1-9.
5. Schaller, R. D.; **Pietryga, J. M.**; Goupalov, S. V.; Petruska, M. A.; Ivanov, S. A. and V.I. Klimov, Breaking the phonon bottleneck in semiconductor nanocrystals via multiphonon emission induced by intrinsic nonadiabatic interactions. *Phys. Rev. Lett.*, **2005**, 95, 196401.
4. **Pietryga, J.M.**; Schaller, R.D.; Werder, D.J.; Stewart, M.H.; Klimov, V.I. and J.A. Hollingsworth, Pushing the band gap envelope: Mid-infrared emitting colloidal PbSe quantum dots. *J. Am. Chem. Soc.*, **2004**, 126(38), 11752-3; reprinted in *Journal of the Intelligence Community Research and Development*, April 2007.
3. **Pietryga, J.M.**; Jones, J.N.; Mullins, L.A.; Wiacek, R.J. and A.H. Cowley, An unprecedented mode of ligation for a bridged amido-cyclopentadienide (constrained geometry) ligand;  $\pi$ -olefinic interactions with gallium and indium. *Chem. Commun.*, **2003**(16), 2072-3.
2. Wiacek, R.J.; Macdonald, C.L.B.; Jones, J.N.; **Pietryga, J.M.** and A.H. Cowley, The contrasting behaviour of bridged amido-cyclopentadienyl (constrained geometry) group 15 chlorides and cations derived therefrom. *Chem. Commun.*, **2003**(3), 430-1.
1. **Pietryga, J.M.**; Gorden, J.D.; Macdonald, C.L.; Voigt A; Wiacek, R.J. and A.H. Cowley, Main group "constrained geometry" complexes. *J. Am. Chem. Soc.*, **2001**, 123(31), 7713-4.

## PATENTS

Schaller, R.D.; Zhuravlev, K.K.; **Pietryga, J.M.**; Whitehead, M. and R.K. Sander, Real Time Measurement Of Shock Pressure, U.S. Patent No. 8,135,244, issued 3/13/2012.

Hollingsworth, J.A. and **J.M. Pietryga**, Surface-Treated Lead Chalcogenide Nanocrystal Quantum Dots, U.S. Patent Application No. 20080057311, filed 8/31/2006.

## SYMPOSIA ORGANIZED

“Emerging developments in nanomaterials for energy applications.” **J.M. Pietryga** and M.G. Kanatzidis, co-organizers, American Chemical Society 243<sup>rd</sup> National Meeting and Exposition, to be held Mar. 25-29, **2012**, San Diego, CA.

“The Materials Chemistry of Solar Energy Capture.” **J.M. Pietryga** and J.M. Papanikolas, co-organizers, American Chemical Society 242<sup>nd</sup> National Meeting and Exposition, Aug. 28-Sept. 1, **2011**, Denver, CO.

## INVITED PRESENTATIONS

“Colloidal nanocrystals as the building blocks for 3<sup>rd</sup>-generation solar cells.” **Pietryga, J.M.**, *invited seminar*, Department of Chemical Engineering, New Mexico State University, November 9, **2012**, Las Cruces, NM.

“The surface chemistry of lead chalcogenide nanocrystals: Constructing a better photovoltaic material one atomic layer at a time.” **Pietryga, J.M.**, *invited talk*, 2012 Center for Revolutionary Solar Photoconversion Joint Research Symposium and Annual Meeting, August 28-31, **2012**, Boulder, CO.

“Colloidal Nanomaterials as the Building Blocks for Next-Generation Solar Cells.” **Pietryga, J.M.**, *invited talk*, 2011 American Institute of Chemical Engineers Annual Meeting, October 16-21, **2011**, Minneapolis, MN.

“An Overview of the Center for Advanced Solar Photophysics.” **Pietryga, J.M.**, *invited talk*, 2011 Center for Revolutionary Solar Photoconversion Annual Meeting, September 11-13, **2011**, Golden, CO.

“The chemistry of solar-relevant nanocrystal quantum dots.” **Pietryga, J.M.**, *invited seminar*, Center for Advanced Solar Photophysics 2011 Summer Workshop, July 8-9, **2011**, Irvine, CA.

“Development of novel nanomaterials as the building blocks for next-generation solar cells.” **Pietryga, J.M.**, Lee, D.C.; Robel, I. and V.I. Klimov, *invited talk*, American Vacuum Society 57<sup>th</sup> International Symposium and Exhibition, October 17-22, **2010**, Albuquerque, NM.

“The influence of structure on carrier dynamics in a new class of infrared-active nanoheterostructures.” **Pietryga, J.M.**, Lee, D.C.; Robel, I. and V.I. Klimov, *invited talk*, Functionalized Nanomaterials: Bio helps Nano, April 26-28, **2010**, Santa Fe, NM.

“Nanotechnology Discussion,” Rio Grande Section of the American Industrial Hygiene Association, *invited panelist*, July 23, **2009**, Albuquerque, NM.

“The synthesis and characterization of the world's greatest infrared fluorophores.” **Pietryga, J.M.**, *invited seminar*, GE Global Research, Oct. 19, **2007**, Niskayuna, NY.

“Cadmium-stabilized lead selenide nanocrystals for use in solar cells.” **Pietryga, J.M.**; Casson, J.L.; Schaller, R.D.; Klimov, V.I. and J.A. Hollingsworth, *invited talk*, American Chemical Society 234<sup>th</sup> National Meeting and Exposition, Aug. 19-23, **2007**, Boston, MA.

“Stable, highly luminescent infrared nanocrystal quantum dots: synthesis and application.” **J.M. Pietryga**, *invited talk*, Community Academic Research Summit, co-sponsored by DIA and NGA, June 11-13, **2007**, Williamsburg, VA.

## CONTRIBUTED PRESENTATIONS

“Optimization of solution-processed semiconductor nanocrystal films and composites for gamma-ray scintillation.” Padilha, L.A., Bae, W.K., Schaller, R.D. and **Pietryga, J.M.**, *oral*, Materials Research Society Spring Meeting, April 9-13, **2012**, San Francisco, CA.

“The development of solution-processed semiconductor nanocrystal films as gamma-ray scintillators.” Padilha, L.A., Bae, W.K., Schaller, R.D. and Petryga, J.M., *oral*, Materials Research Society Fall Meeting, Nov. 28 – Dec. 2, **2011**, Boston, MA.

“The effect of structure on carrier separation in a series of infrared-emitting type-II nanoheterostructures.” Petryga, J.M., Lee, D.C.; Robel, I. and V.I. Klimov, *oral*, American Physical Society March Meeting, March 15-19, **2010**, Portland, OR.

“Infrared-emitting Type-II Heterostructured Semiconductor Nanocrystals.” Petryga, J.M.; Lee, D.C.; Robel, I. and V.I. Klimov, *oral*, Materials Research Society Fall Meeting, Nov. 30 - Dec. 4, **2009**, Boston, MA.

“Synthesis of infrared-active heterostructured semiconductor nanocrystals for photovoltaic applications.” Petryga, J.M.; Lee, D.C.; Robel, I. and V. I. Klimov, *oral*, American Chemical Society 238<sup>th</sup> National Meeting and Exposition, Aug. 16-20, **2009**, Washington, DC.

“Carrier behavior in a quantum-confined material under high applied pressures: Fundamental insights.” Petryga, J.M.; Zhuravlev, K.K.; Klimov, V.I. and R.D. Schaller, *oral*, Materials Research Society Fall Meeting, Dec. 1-5, **2008**, Boston, MA.

“Heterostructured nanocrystal quantum dots based on lead chalcogenides.” Petryga, J.M.; Lee, D.C.; Hollingsworth, J.A. and V.I. Klimov, *oral*, American Chemical Society 236<sup>th</sup> National Meeting and Exposition, Aug. 17-21, **2008**, Philadelphia, PA.

“Utilizing the lability of lead chalcogenides to produce heterostructured nanocrystals with bright, stable infrared emission.” Petryga, J.M. and J.A. Hollingsworth, *oral*, Particles 2008, May 10-13, **2008**, Orlando, FL.

“Stable, highly luminescent infrared nanocrystal quantum dots.” J.M. Petryga, *oral*, Intelligence Community Research Fellowship Program Colloquium, Apr. 30-May 3, **2007**, Chantilly, VA.

“PbSe nanocrystal quantum dots at high pressures: Competition between bulk and confinement effects.” Petryga, J.M.; Schaller, R.D.; Zhuravlev, K.K.; Sander, R.K. and V.I. Klimov, *oral*, 2006 Materials Research Society Fall Meeting, Nov. 27-Dec. 1, **2006**, Boston, MA.

“Cadmium-treated PbSe nanocrystal quantum dots: Bright, air-stable infrared emitters.” Petryga, J.M.; Casson, J.L.; Werder, D.J.; Klimov, V.I. and J.A. Hollingsworth, *oral*, American Chemical Society 232<sup>nd</sup> National Meeting and Exposition, Sept. 10-14, **2006**, San Francisco, CA.

“Amplified spontaneous emission in the single-exciton regime using colloidal type II core/shell nanocrystals.” Ivanov, S.A.; Petryga, J.M.; Bezel, I.V.; Nanda, J.; Piryatinski, A.; Achermann, M. and V. I. Klimov, *oral*, 4<sup>th</sup> International Conference on Quantum Dots, May 1-5, **2006**, Chamonix-Mont Blanc, France.

“Bright, stable infrared emission from Cd-enhanced PbSe nanocrystal quantum dots.” Petryga, J.M.; Casson, J.L.; Werder, D.J.; Nanda, J.; Klimov, V.I. and J.A. Hollingsworth, *poster*, 4<sup>th</sup> International Conference on Quantum Dots, May 1-5, **2006**, Chamonix-Mont Blanc, France.

“Stable, highly luminescent infrared nanocrystal quantum dots.” J.M. Petryga, *poster*, Intelligence Community Research Fellowship Program Colloquium, Apr. 17-19, **2006**, McLean, VA.

“Bright, stable high-energy PbSe nanocrystal quantum dots.” Petryga, J.M.; Casson, J.L.; Nanda, J.; Schaller, R.; Klimov, V.I. and J.A. Hollingsworth, *oral*, 2005 Materials Research Society Fall Meeting, Nov. 28-Dec. 2, **2005**, Boston, MA.

“Synthesis of stable near- to mid-infrared emitting PbSe nanocrystals in high yield.” Petryga, J.M.; Schaller, R.D.; Nanda, J.; Salazar, K.V.; Casson, J.L.; Klimov, V.I. and J.A. Hollingsworth, *oral*, 2005 Materials Research Society Spring Meeting, Mar. 28-Apr. 1, **2005**, San Francisco, CA.

“PbSe Nanocrystal Quantum Dots: From Liquid Crystal Formers to Mid-IR Emitters.” **Pietryga, J.M.**; Schaller, R.D.; Jeong, S.; Stewart, M.H.; Nanda, J.; Klimov, V.I. and J.A. Hollingsworth, *poster*, 3<sup>rd</sup> International Conference on Quantum Dots, May 10-13, **2004**, Banff, Alberta, Canada.

“Pushing the band gap envelope: PbSe quantum dots emitting at 3 microns and beyond.” **Pietryga, J.M.**; Hollingsworth, J.A.; Klimov, V.I.; Schaller, R.D.; Stewart, M.H. and J. Nanda, *oral*, American Chemical Society 227<sup>th</sup> National Meeting and Exposition, Mar. 28-Apr. 1, **2004**, Anaheim, CA.

“Structural variation in titanium hydrazides.” **J.M. Pietryga** and A.H. Cowley, *oral*, American Chemical Society 223<sup>rd</sup> National Meeting and Exposition, Apr. 7-11, **2002**, Orlando, FL.

## PROFESSIONAL ACTIVITIES

- Novel NanoMaterials Thrust Leader, *Center for Advanced Solar Photophysics*
- Member, *American Chemical Society, Materials Research Society, American Institute of Chemical Engineers, American Physical Society*
- Editorial Board Member, *Dataset Papers in Nanotechnology*
- Reviewer, *Journal of the American Chemical Society, ACS Nano, Chemistry of Materials, Journal of Physical Chemistry, Langmuir, ACS Applied Materials & Interfaces, Chemical Science*
- Proposal Reviewer, *National Science Foundation, Department of Energy Office of Basic Energy Sciences, ACS Petroleum Research Fund*
- Group Representative, *Chemistry Division Worker Safety and Security Team*

## HONORS AND AWARDS

- Los Alamos Achievement Award, Team, “For outstanding contribution as a member of the Quantum Dot Emitters Field Test Team.” 2006
- IC Postdoctoral Research Fellowship, 2005
- Los Alamos Achievement Award, Individual, “For outstanding contributions to the infrared nanocrystal quantum dot (NQD) project.” 2005
- Faraday Fellowship for Teaching Excellence, 2002
- Dorothy Banks Fellowship, 2001
- NSF Graduate Fellowship Award Honorable Mention, 1998
- Leon Morgan Fellowship, 1997-1998
- Welch Foundation Fellowship, 1997-1998
- Harry H. Blecker Scholarship in Chemistry, 1996
- Honors Program Travel Award, 1996
- Angell Scholar, 1994-1997
- UAW/Nationsbank/Saturn Corp. Scholarship, 1994-1996
- ACS Polymer Division Award for Achievement in Organic Chemistry, 1994
- Branstrom Freshman Prize, 1994
- Class Honors, 1993-1997
- Honors Program Scholarship, 1993-1997
- Flint Scholar, 1993-1997
- National Merit Scholarship, 1993